

## CLAIMS

### WHAT IS CLAIMED IS:

1. An information storage medium in which data is recorded in recording units, each of the recording units comprising:
  - a body including user data and a first recognizer; and
  - a head which is arranged in front of the body to protect the body and includes a second recognizer to protect the first recognizer,wherein the second recognizer comprises more patterns than a number of maximum length patterns used to form the first recognizer so that the second recognizer is distinguished from the first recognizer.
2. The information storage medium of claim 1, wherein the recording unit further comprises a tail which is arranged behind the body and includes a third recognizer.
3. The information storage medium of claim 1, wherein when a run length limited (1, 10) modulation code is used, the first recognizer uses a 12T pattern, and the second recognizer uses two 12T patterns.
4. The information storage medium of claim 1, wherein when a run length limited (1, 10) modulation code which modulates 8-bit data into a 12-bit codeword is used, the first recognizer uses a 13T pattern, and the second recognizer uses two 13T patterns.
5. The information storage medium of claim 1, wherein the second recognizer is located in a rear part of the head.
6. The information storage medium of claim 1, wherein a mark or a pit with a specific length is repeatedly recorded for a length of A number of bytes in the head for a data phase locked loop.

7. The information storage medium of claim 6, wherein a pattern '010001000100' is used so that the mark or pit with the specific length is repeated.

8. The information storage medium of claim 6, wherein the length of the A byte is 68.

9. The information storage medium of claim 6, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as a recognition pattern for the second recognizer, which identifies the head.

10. The information storage medium of claim 6, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as a recognition pattern for the second recognizer, which identifies the head, and the recognition pattern is connected to a pattern in front of the recognition pattern.

11. The information storage medium of claim 9, wherein a pattern '000000000010000000000001' is used to form the second recognizer.

12. The information storage medium of claim 10, wherein a pattern '000000000010000000000001' is used to form the second recognizer.

13. The information storage medium of claim 9, wherein the length of the B bytes is 2.

14. The information storage medium of claim 10, wherein the length of the B bytes is 2.

15. The information storage medium of claim 9, wherein a phase locked loop pattern subsequent to the pattern for the second recognizer is a repetition of a mark or pit with a specific length during a residual C number of bytes of the head.

16. The information storage medium of claim 10, wherein a phase locked loop pattern subsequent to the pattern for the second recognizer is a repetition of a mark or a pit with a specific length during a residual C number of bytes of the head.

17. The information storage medium of claim 15, wherein a pattern '000100010001' is used for the repetition of the mark or the pit with the specific length.

18. The information storage medium of claim 15, wherein the length of the C bytes is 1.

19. An information storage medium in which data is recorded in recording units, each of the recording units comprising:

a body including user data, an error correction parity, and an error correction code (ECC) sync; and

a head which is disposed in front of the body to protect the body,  
wherein the head includes a head identifying pattern which is unique such that the head identifying pattern cannot be detected from any other patterns.

20. The information storage medium of claim 19, wherein the head identifying pattern is disposed in a rear part of the head and comprises a head closing mark, which marks a closing of the head.

21. The information storage medium of claim 20, wherein the head closing mark comprises more patterns than a number of maximum length patterns used to form the ECC sync so that the head closing mark is distinguished from the ECC sync.

22. The information storage medium of claim 20, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a closing of the tail.

23. The information storage medium of claim 19, wherein a mark or a pit with a specific length is repeatedly recorded for a length of A number of bytes in the head for a data phase locked loop.

24. The information storage medium of claim 23, wherein a pattern '010001000100' is used so that the mark or pit with the specific length is repeated.

25. The information storage medium of claim 23, wherein the length of the A bytes is 68.

26. The information storage medium of claim 23, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as the head identifying pattern.

27. The information storage medium of claim 23, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as a recognition pattern for the second recognizer, which identifies the head, and the recognition pattern is connected to a pattern in front of the recognition pattern.

28. The information storage medium of claim 26, wherein a pattern '000000000010 000000000001' is used to form the head identifying pattern.

29. The information storage medium of claim 27, wherein a pattern '000000000010 000000000001' is used to form the head identifying pattern.

30. The information storage medium of claim 26, wherein the length of the B bytes is 2.

31. The information storage medium of claim 27, wherein the length of the B bytes is 2.

32. The information storage medium of claim 26, wherein the mark or the pit with the specific length is repeated for a length of C number of bytes so that the head identifying pattern and a pattern connected to the head identifying pattern provide a data phase locked loop .

33. The information storage medium of claim 27, wherein the mark or the pit with a specific length is repeated for a length of C number of bytes so that the head identifying pattern and a pattern connected to the head identifying pattern provide a data phase locked loop.

34. The information storage medium of claim 32, wherein a pattern '000100010001' is used for a repetition of the mark or the pit with the specific length.

35. The information storage medium of claim 32, wherein the length of the C bytes is 1.

36. An apparatus for reproducing data recorded on a disk in recording units, each of the recording units comprising: a body including user data and a first recognizer; and a head which is disposed in front of the body to protect the body and includes a second recognizer to protect the first recognizer, wherein the second recognizer comprises more patterns than a number of maximum length patterns used to form the first recognizer so that the second recognizer is distinguished from the first recognizer, the apparatus comprising:

a pickup which detects a radio frequency signal from the disk; and

a binary decoder which receives the radio frequency signal from the pickup and, if the second recognizer is detected and the first recognizer is detected from a data area predetermined in the second recognizer, determines from the first recognizer that the body starts and obtains binary data from the radio frequency signal.

37. The apparatus of claim 36, wherein if the second recognizer is detected but the first recognizer is not detected from a data area ranging from the second recognizer to a predetermined point, the binary decoder inserts the first recognizer into a location, which is a predetermined distance apart from the second recognizer, and determines from the inserted first recognizer that the body starts.

38. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder determines from the first recognizer that the body starts.

39. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder re-searches for the second recognizer.

40. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder obtains a first recognizer using a first recognizer protection routine and re-searches for the second recognizer.

41. The apparatus of claim 36, wherein if the second recognizer is detected and the first recognizer is detected from a data area ranging from the second recognizer to a predetermined point, the binary decoder sets a window to protect syncs included in the body based on the detected first recognizer.

42. The apparatus of claim 36, wherein if the second recognizer is detected and the first recognizer is not detected from a data area ranging from the second recognizer to a predetermined point, the binary decoder inserts the first recognizer into a location, which is a predetermined distance apart from the second recognizer, and sets a window for protecting the syncs included in the body based on the inserted first recognizer.

43. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder sets a window to protect syncs included in the body based on the detected first recognizer.

44. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder re-searches for the second recognizer.

45. The apparatus of claim 36, wherein the recording unit further comprises a tail which is disposed behind the body and includes a third recognizer, and if the second recognizer is not detected and the first recognizer is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder obtains a first recognizer using a first recognizer protection routine and re-searches for the second recognizer.

46. An apparatus for reproducing data recorded on a disk in recording units, each of the recording units comprising: a body including user data, an error correction parity, and an ECC sync; and a head which is disposed in front of the body to protect the body, the head further including a head identifying pattern disposed in a data area, the head identifying pattern being unique such that the head identifying pattern cannot be detected from any other data areas, the apparatus comprising:

a pickup which detects a radio frequency signal from the disk; and



a binary decoder which receives the radio frequency signal from the pickup and, if the head identifying pattern is detected and the ECC sync is detected from a data area ranging from the head identifying pattern to a predetermined point, the binary decoder determines from the ECC sync that the body starts and obtains binary data from the radio frequency signal.

47. The apparatus of claim 46, wherein the head identifying pattern is disposed in a second half of the head and comprises a head closing mark, which marks a closing of the head, and the head closing mark comprises more patterns than a number of maximum length patterns used to form the ECC sync so that the head closing mark is distinguished from the ECC sync.

48. The apparatus of claim 46, wherein if the head closing mark is detected but the ECC sync is not detected from a data area ranging from the second recognizer to a predetermined point, the binary decoder inserts the ECC sync into a location, which is a predetermined distance apart from the head closing mark and determines from the inserted ECC sync that the body starts.

49. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks the opening of the tail, and if the head closing mark is not detected and the ECC sync is detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, the binary decoder determines from the ECC sync that the body starts.

50. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which informs the opening of the tail, and if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, the binary decoder re-searches for the head closing mark.



51. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which informs the opening of the tail, and if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, the binary decoder obtains an ECC sync using an ECC sync protection routine and re-searches for the head closing mark.

52. The apparatus of claim 47, wherein if the head closing mark is detected and the ECC sync is detected from a data area ranging from the head closing mark to a predetermined point, the binary decoder sets a window to protect the syncs included in the body based on the detected ECC sync.

53. The apparatus of claim 47, wherein if the head closing mark is detected and the ECC sync is not detected from a data area ranging from the head closing mark to a predetermined point, the binary decoder inserts the ECC sync into a location, which is a predetermined distance apart from the head closing mark and sets a window to protect the syncs included in the body based on the inserted ECC sync.

54. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks the opening of the tail, and if the head closing mark is not detected and the ECC sync is detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, the binary decoder sets a window to protect the syncs included in the body based on the detected ECC sync.

55. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks the opening of the tail, and if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, the binary decoder re-searches for the head closing mark.

56. The apparatus of claim 47, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks the opening of the tail, and if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, the binary decoder obtains the ECC sync using an ECC sync protection routine and re-searches for the head closing mark.

57. A method of recording data on a recordable information storage medium, the method comprising:

recording data in recording units,

wherein each of the recording units comprises: a body including user data and a first recognizer; and a head which is disposed in front of the body to protect the body and includes a second recognizer to protect the first recognizer, wherein the second recognizer comprises more patterns than a number of maximum length patterns used to form the first recognizer so that the second recognizer is distinguishable from the first recognizer.

58. The method of claim 57, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a third recognizer.

59. The method of claim 57, wherein when a run length limited (1, 10) modulation code is used, the first recognizer uses a 12T pattern, and the second recognizer uses two 12T patterns.

60. The method of claim 57, wherein when a run length limited (1, 10) modulation code which modulates 8-bit data into a 12-bit codeword is used, the first recognizer uses a 13T pattern, and the second recognizer uses two 13T patterns.

61. The method of claim 57, wherein the second recognizer is located in a rear part of the head.

62. The method of claim 57, wherein a mark or a pit with a specific length is repeatedly recorded for a length of A number of bytes in the head for a data phase locked loop.

63. The method of claim 62, wherein a pattern '010001000100' is used so that the mark or the pit with the specific length is repeated.

64. The method of claim 62, wherein the length of the A bytes is 68.

65. The method of claim 62, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as a recognition pattern for the second recognizer, which identifies the head.

66. The method of claim 62, wherein a pattern not detectable from any other patterns is used for a length of B number of bytes as a recognition pattern for the second recognizer, which identifies the head, and the recognition pattern is connected to a pattern in front of the recognition pattern.

67. The method of claim 65, wherein a pattern '000000000010000000000001' is used to form the second recognizer.

68. The method of claim 66, wherein a pattern '000000000010000000000001' is used to form the second recognizer.

69. The method of claim 65, wherein the length of the B bytes is 2.

70. The method of claim 66, wherein the length of the B bytes is 2.

71. The method of claim 65, wherein a phase locked loop pattern subsequent to the pattern for the second recognizer is a repetition of a mark or pit with a specific length during a residual C number of bytes of the head.

72. The method of claim 66, wherein a phase locked loop pattern subsequent to the pattern for the second recognizer is a repetition of a mark or pit with a specific length during a residual C number of bytes of the head.

73. The method of claim 71, wherein a pattern '000100010001' is used for a repetition of the mark or the pit with the specific length.

74. The method of claim 71, wherein the length of the C bytes is 1.

75. The method of claim 57, wherein the user data is recorded in units of ECC blocks, the first recognizer is an ECC sync, the second recognizer is a head closing mark, which marks an end of the head, and the third recognizer is a tail opening mark, which marks a start of the tail.

76. A method of protecting syncs included in data that is recorded on a recordable disk in recording units, each of the recording units comprising: a body including user data, an error correction parity, and an ECC sync; and a head which is disposed in front of the body to protect the body, wherein the head includes a head identifying pattern which is unique such that the head identifying pattern cannot be detected from any other patterns, the method comprising:  
if the head identifying pattern is detected and the ECC sync is detected from a data area ranging from the head identifying pattern to a predetermined point, determining from the ECC sync that the body starts.

77. The method of claim 76, wherein the head identifying pattern is disposed in a rear part of the head and comprises a head closing mark, which marks an end of the head, and the head closing mark comprises more patterns than a number of maximum length patterns used to form the ECC sync so that the head closing mark is distinguishable from the ECC sync.

78. The method of claim 77, further comprising, if the head closing mark is detected but the ECC sync is not detected from a data area ranging from the second recognizer to a predetermined point, inserting the ECC sync into a location, which is a predetermined distance apart from the head closing mark and determining from the inserted ECC sync that the body starts.

79. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, determining from the ECC sync that the body starts.

80. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, re-searching for the head closing mark.

81. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the third recognizer to a predetermined point, obtaining an ECC sync using the ECC sync protection routine and re-searching for the head closing mark.

82. The method of claim 77, further comprising, if the head closing mark is detected and the ECC sync is detected from a data area ranging from the head closing mark to a predetermined point, setting a window to protect the syncs included in the body based on the detected ECC sync.

83. The method of claim 77, further comprising, if the head closing mark is detected and the ECC sync is not detected from a data area ranging from the head closing mark to a predetermined point, inserting the ECC sync into a location, which is a predetermined distance apart from the head closing mark and setting a window to protect the syncs included in the body based on the inserted ECC sync.

84. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, setting a window to protect the syncs included in the body based on the detected ECC sync.

85. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, re-searching for the head closing mark.

86. The method of claim 77, wherein each of the recording units further comprises a tail which is disposed behind the body and includes a tail opening mark, which marks a start of the tail, and the method further comprising, if the head closing mark is not detected and the ECC sync is not detected from a data area ranging from a judged location of the tail opening mark to a predetermined point, obtaining the ECC sync using an ECC sync protection routine and re-searching for the head closing mark.

87. An information storage medium in which data is recorded in recording units, each of the recording units comprising:  
a body including user data and a first recognizer; and

a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer, the second recognizer having a distinctive pattern so that the second recognizer is distinguishable from the first recognizer.

88. An apparatus for reproducing data recorded on a disk in recording units, each of the recording units comprising a body including user data and a first recognizer, and a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer, the second recognizer having a distinctive pattern so that the second recognizer is distinguishable from the first recognizer, the apparatus comprising:

a pickup to detect a recorded signal from the disk; and

a binary decoder to receive the detected signal from the pickup and, if the second recognizer is detected and the first recognizer is detected from a data area predetermined in the second recognizer, to determine from the first recognizer that the body starts and to obtain binary data from the detected signal.

89. A method of recording data on a recordable information storage medium, the method comprising:

recording data in recording units such that each of the recording units includes a body including user data and a first recognizer, and a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer, the second recognizer having a distinctive pattern so that the second recognizer is distinguishable from the first recognizer.

90. An information storage medium in which data is recorded in recording units, each of the recording units comprising:

a body including user data and a first recognizer; and

a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer by extending a margin in which data is linked between the head and the body of each respective recording unit.



91. An apparatus for reproducing data recorded on a disk in recording units, each of the recording units comprising a body including user data and a first recognizer, and a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer by extending a margin in which data is linked between the head and the body of each respective recording unit, a pickup to detect recorded signals from the disk, the apparatus comprising:

a decoder to receive the detected signal from the pickup and, if the first recognizer is detected according to information in a detected second recognizer, to link the head with the body of a respective one of the recording units and to obtain data from the detected signal.

92. A method of protecting the syncs included in data that is recorded on a recordable disk in recording units, each of the recording units including a body including user data and a first recognizer, and a head arranged preceding the body to safeguard the body, and including a second recognizer to safeguard the first recognizer by extending a margin in which data is linked between the head and the body of each respective recording unit, and a pickup to detect signals from the recordable disk, the method comprising:

if the error correction code sync is detected according to information detected from a data area ranging from the head identifying pattern to a predetermined point, linking the head with the body of a respective one of the recording units and obtaining data from the detected signal.